

Late Holocene Eruptive History of Popocatepetl Volcano, Mexico: Implications for Future Hazards

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Introduction

The December, 1994 eruption of Popocatepetl volcano in central Mexico served as a warning of possible future catastrophes. The evacuation of 50,000 people by civil protection authorities may have been a dress rehearsal for a cataclysmic Plinian eruption that could effect 30,000,000 people living within 80 km of the volcano. To better evaluate the potential risk posed by Popo, we have been doing detailed mapping of the Late Holocene deposits around the volcano. Our findings show that activity is characterized by recurrent Plinian eruptions of considerable magnitude every 1000 to 2000 years. The last two of these destroyed settlements and buried cities in the vicinity, and so are particularly relevant for risk assessment..

Stratigraphy of deposits

Detailed stratigraphic analyses of over 150 outcrops, and over 40 C-14 dates have elucidated the eruptive history for the Late Holocene. The last two major eruptions occurred 2500-2100 y. BP and 1255-1095 y. BP. Both were quite devastating, and followed a similar eruptive pattern. Minor ash fall and ash flows were followed by hydromagmatic eruptions at the summit-crater that produced a series of hot pyroclastic surges. This activity peaked with a major Plinian eruption whose column reached stratospheric heights and produced thick Plinian pumice fall deposits. The dispersal axes were to the NE for the older eruption, and to the E for the younger. The eruptions culminated with emplacement of ash flows and mudflows radially away from the volcano. Pumice deposits reach a maximum exposed thickness of 1.5 m near the vents, and are found up to 50 km away. Chemical composition of the two pumice falls is almost identical, suggesting the existence of a large and long-lived magma chamber.

Impact of the eruptions

The high valleys of Central Mexico have been ideal for cultural development due to fertile soils, temperate climate, availability of water, etc. By 2500 y. BP. the areas around Popo were settled, and cultivated. Directly underneath and buried by the Plinian pumice deposit of the older eruption are found agricultural furrows, housing structures, and domestic artifacts; these are widespread, pointing to a direct impact of the eruption. In addition, archaeologists report that settlements in the area

appear to have suffered a dramatic decline in population at about this time. By 800 AD, the area was heavily populated; the ancient cities of Teotihuacan and Cholula had reached their cultural peak and the Classic Period of Meso-American civilization was near its end. Archaeologists report that suddenly, at about 800 AD, the ceremonial center of Cholula was abandoned. Our studies provide a direct link between the younger Popo eruption, and this decline: at least 70,000 km² were devastated, including the "food basket" region near Cholula. In addition, we have found 3m flood deposits, dated at 810 AD, lapping the base of the great pyramid at Cholula, indicating that the city was buried under thick mud.

Conclusions

The last two major eruptions of Popocatepetl occurred in historic times, and precipitated large natural disasters. The older occurred between 520 and 225 BC, and the younger very probably in 822 or 823 AD. Assuming a rough periodicity of eruptions, the next one can be expected between 1869 and 2164. Equally unsettling is our lack of knowledge about the significance of the present emission of ash and high SO₂ emissions.

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